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**SASKATCHEWAN PORK INDUSTRY SUSTAINABILITY**

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Saskatchewan





**THE PORK INDUSTRY  
AGRI-FOOD INNOVATION FUND  
SUMMARY OF RESEARCH PROJECTS FUNDED  
1998-2005**

**Submitted by**

**Sask Pork - May 2006**



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PROJECT: FLAX SEED AND FRACTIONS AS AN ANTIBIOTIC REPLACEMENT IN  
SWINE DIETS  
SASK PORK PROJECT # 2002-11

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Project Summary:

In an Expert Advisory Committee on Animal Uses of Antimicrobials and Impact on Resistance and Human Health report to Health Canada, the committee made numerous recommendations to further regulate anti-microbial use including elimination of over-the-counter anti-microbial sales for livestock and rapid phasing out of anti-microbials for growth promotion which do not meet strict criteria. The Canadian swine industry is likely to experience highly restricted access to anti-microbials in the near future and will require alternatives to the prophylactic and growth promoting use of antibiotics.

Flax seed may have desirable nutrient and antibiotic characteristics for swine, however, effects of flax seed or flax fractions on intestinal microbial populations are unknown. This project will test effects of flax seed and fractions on intestinal microbial populations, but the nutritional value of flax seed and fractions will also be measured.

Start Date: January 2003  
Completion Date: March 31, 2004  
Progress Reports: April 5, 2004 – FINAL REPORT

Summary of Results

Increasing pressure to discontinue the feeding of growth-promoting antibiotics has prompted examination of novel feed ingredients and their effect on intestinal microbial ecology. The impact of low-level inclusion of antibiotics in swine diets, together with flaxseed, or flaxseed fractions on small intestinal microbial profiles was investigated in growing pigs with the support of Sask Pork (\$20,000) and the SAFRR Agri-value Program (\$20,000). Small intestine digesta was collected and the change caused by antibiotics in swine diets was reflected by flaxseed hulls and flax oil, but not by flax seed and hot-water extracted flax seed. These results strongly suggest that flaxseed hulls and flax oil are candidate value-added ingredient fractions to consider as antibiotic replacement.



**PROJECT: RENOVATION TO INCREASE SWINE RESEARCH AT VETERINARY  
INFECTIOUS DISEASE ORGANIZATION (VIDO)  
SASK PORK PROJECT # 2002-10**

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Project Summary:

Research to improve both general and specific immunity in swine has become a focus of swine research at VIDO. The objectives of research projects at VIDO to control swine disease are to develop platform vaccine technologies and disease control strategies based on a fundamental understanding of swine immunity. Recent reports of swine research done at VIDO that have been published or are in the press reflect progress in vaccine development for Actinobacillus pleuropneumoniae, pathogenesis of Streptococcus suis and needle free immunization of swine. Fundamental research on ways to stimulate swine immunity is also underway.

One of the ways to improve the mucosal immune response is by including immunostimulatory DNA motifs in the vaccine formulation. A higher level of secretory IgA in nasal secretions of immunized pigs has been observed when the vaccine included immunostimulatory DNA motifs.

This increase in swine research has completely utilized all of VIDO's swine housing facilities resulting in 6-8 month delays before promising and approved projects can be started. The project consists of retrofitting two rooms to accommodate increased swine research on immunity and disease control that will comply with federal guidelines for experiments involving the types of organisms VIDO is working with (biological hazard level 2).

Start Date: February 2003  
Completion: April 2003  
Progress Reports: September 17, 2002 - FINAL REPORT\*  
\* Electronic copy available

## Summary of Results

Research to improve both general and specific immunity in swine has become a focus of swine research at VIDO. The objectives of research projects at VIDO to control swine disease are to develop platform vaccine technologies and disease control strategies based on a fundamental understanding of swine immunity. Recent reports of swine research done at VIDO that have been published or are in press reflect progress in vaccine development for *Actinobacillus pleuropneumoniae*, pathogenesis of *Streptococcus suis* and needle free immunization of swine. Fundamental research on ways to stimulate swine immunity is also underway.

One of the ways to improve the mucosal immune response is by including immunostimulatory DNA motifs in the vaccine formulation. We have observed a higher level of secretory IgA in nasal secretions of immunized pigs when the vaccine included immunostimulatory DNA motifs. This increase in swine research meant that when project #2002-10 began, all our swine housing facilities were completely utilized with 6 to 8 month delays before promising and approved projects could be started. Now, with the renovation of 2 rooms for swine research completed, we are doing increased research on swine immunity and disease control.

PROJECT: SIGNIFICANCE AND PATHOGENESIS OF AIDA-1 *E. COLI* INFECTION  
IN PIGS  
SASK PORK PROJECT #2002-09

Drs. Dorothy Middleton and Elemir Simko  
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Project Summary:

The proposal will investigate the significance and pathogenesis of AIDA-1 *E. coli* infection in neonatal piglets to test the following hypotheses:

- All *E. coli* isolates positive for AIDA-1 cause neonatal diarrhea with characteristic morphologic lesions;
- AIDA-1 adhesin play a significant role in attachment and colonization of intestines;
- Expression of intestinal receptors for AIDA-1 is age-associated..

Expected results:

This study will determine clinical significance of infection in piglets with AIDA-1 *E. coli*. Providing that the predictions are correct, this study will also determine if AIDA-1 adhesin is an important pathogenic virulence factor with potential for future use in vaccination and prevention of AIDA-1 *E. coli* induced diarrhea. Determination of age-associated expression of receptors for AIDA-1 adhesin will facilitate future planning of immunization protocols and prevention of porcine diarrhea associated with AIDA-1 *E. coli*.

Start Date: January 2003  
Completion: March 2004  
Progress Reports: April 21, 2004 - FINAL REPORT

Summary of Results

*Escherichia coli* is one of the most common causes of neonatal diarrhea in piglets resulting in marked direct and indirect economic losses. To cause diarrhea *E. coli* must attach to the intestinal surface using adhesive factors termed fimbriae and adhesions ("like a bot to a dock"). Our diagnostic laboratory (serving Alberta and Saskatchewan) is experiencing an increase in the number of submitted cases of porcine diarrhea associated with *E. coli*

bacteria that lack the expression of known attachment factors for pigs. In previous studies, *E. coli* was isolated from 170 clinical cases of porcine diarrhea and only 25 isolates were positive for known pathogenic attaching factors in pigs. Additional 15 isolates were positive for an attachment factor called AIDA-1 (adhesin involved in diffuse adherence), the pathogenicity of which has not been determined in porcine diarrhea. AIDA-1 *E. coli* has been associated with diarrhea in children and subsequent studies have demonstrated that two *E. coli* isolates positive for AIDA-1 adhesin caused diarrhea in colostrums-deprived piglets. Little is yet known about the prevalence, significance and pathogenesis of AIDA-1 *E. coli* in people and even less in pigs.

The research project investigated:

- i) prevalence and significance of AIDA-1 *E. coli* in modern swine industry in Saskatchewan and Alberta;
- ii) mechanisms of bacterial attachment to intestinal surface (a crucial step of infection, the understanding of which is necessary for development of preventive measures/vaccines),
- iii) intestinal receptors ("handles") that bacterial adhesion factors ("arms") attach to, and
- iv) age associated expression of intestinal receptors for AIDA-1 *E. coli*.

The research group realized substantial progress in this project in the first year. Namely,

- i) AIDA-1 adhesin was isolated and purified from AIDA-1 *E. coli*;
- ii) the identity of the isolated protein was confirmed by partial amino acid sequencing;
- iii) anti-AIDA polyclonal antibodies were obtained by immunization of rabbits;
- iv) comparative detection by co-agglutination and immuno-dot blot of AIDA-1 positive and negative *E. coli* isolates was performed.
- v) investigation of mechanisms of AIDA-1 *E. coli* attachment has been initiated; namely a mutant strain of AIDA-1 *E. coli* was designed by genetic deletion of AIDA-1. Genes with consequent loss of the expression of AIDA-1 protein by mutant bacteria.

**PROJECT: DEVELOPMENT OF ARTIFICIAL SWINE ODOR (ASO)  
SASK PORK PROJECT #2002-06**

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The objective of the project is to develop an artificial swine odour (ASO) for screening people to be eligible panelists and calibrating a panelist sense of smell to measure odour intensity of non-diluted odours away from source.

Odours generated from swine operations continue to be a major concern in the prairie provinces. Increased pressure from the public and the expansion needs of the pork industry has prompted an urgent need for odour abatement technology development and evaluation, which require a reliable and accurate technology for odour analysis.

In the olfactometry method, the standard approach for odour concentration measurement, n-butanol is used as reference for panel selection and calibration of olfactometry. However, n-butanol is not similar to real environmental odours in character and persistence, which becomes a source of measurement errors.

The improvement in the accuracy of odour analysis will improve the scientific assessment on the appropriate odour control technologies. This will enable pork producers to make well-informed technological and economic decisions to mitigate odours from pork operations. It will also provide regulators with the ability to make proper adjustments to the minimum distance separation based on odour-mitigating technologies proposed by producers.

Start Date: June 2002  
Completion Date: May 2003  
Progress Reports: January 20, 2003  
April 1, 2004 - FINAL REPORT  
August 2004, Supplementary Paper presented to ASAE / CSAE  
annual meeting in Ottawa.\*  
\* Electronic copy available

## Summary of Results

Six swine farms were chosen to represent the swine industry in the Prairie Provinces: three in Alberta and three in Saskatchewan. Liquid swine manure samples were collected from each of these six farms. To remain consistent, odorous air samples were not directly collected from swine farms, but from headspaces of swine manure under laboratory conditions. In total, ten swine manure headspace samples were collected.

During a routine odour measurement service by the Alberta Research Council, it was found that odorous samples collected from wastewater treatment plants had very sharp odour persistence and similar odour characteristics to swine odours. Therefore, three samples from wastewater treatment plants in Lethbridge and Calgary were also collected and analyzed. In total, thirteen odorous air samples were analyzed with Gas Chromatography/Mass Spectrometry (GC/MS), custom-made eight-port olfactometers, and an AromaScan electronic nose.

It was determined through GC/MS analysis that the chromatographs of swine manure headspaces from different farms might differ. However, the chromatographs of swine manure headspaces from the same farm but collected at different times had high similarities. The chromatographs of the swine manure headspaces appeared randomly at any retention time, while the chromatographs of samples from wastewater treatment plants were concentrated in a narrow retention time range (nine to fifteen minutes). Although the difference in chromatographs and chemicals identified, the odour characters of swine manure headspaces and wastewater treatment samples were the same: most odour panellists classified samples of both sources as "manure". Also, samples with differences in chromatographs might have same odour concentration.

Based on the GC/MS analysis results listed and referred from previous researches conducted by different group scientists, seventeen chemicals were selected as candidate components for the ASO recipe. Based on the combination of these three group chemicals and their concentration level, Twenty-four recipes were developed.

Three runs of experiment were conducted to evaluate these twenty-four candidate recipes. The evaluation criteria were: odour character (similarity to swine odour), odour persistence (the sharper, the better), and error pertinence (deviation in olfactometry measurement). As the result recipe 9 was selected as the final ASO recipe. The newly developed artificial swine odour smells similar to swine manure, has low error pertinences in olfactometry measurements, sharp persistence, similar detection threshold as the standard reference n-butanol, and safe to human panels. It can be used as a substitute reference in panel screen, odour measurement, and calibrations of an electronic nose.



**PROJECT: ENVIRONMENTAL ISSUES RESOURCE CENTRE (RENEWAL)  
SASK PORK PROJECT # 2002-04**

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The Environmental Issues Resource Centre began in the spring of 1998 for four reasons and these conditions still exist:

1. Providing a logical and easy-to-use tool for capturing and sorting the growing body of environmental information on the livestock industry;
2. A need for reviewing the world-wide body of information and evaluating its use for the Canadian situation;
3. A need to provide a fact-based and respected source of information on the topic;
4. A resource for pork boards to use when reviewing funding applications regarding environmental projects.

The three-year continuation of the project provides:

1. Continual updating of the database (approaching 1100 references);
2. Critical review and the writing of easy-to-read chapters on 14 issue areas on the environment;
3. Targeted communications plan and promotional/publication activities to promote this resource to the industry;
4. New Internet features such as web page stats and tracking to better identify why people come to the site and allow improved resource allocation by increasing content in the areas our visitors are seeking;
5. Linking to the website proposed for the Pork Industry Interpretive Centre, providing a value-added resource for students and visitors.

Start Date: 2002  
Completion Date: 2004  
Progress Reports: March 1, 2004

**PROJECT:   ENGINEERING CONTROLS FOR REDUCING H<sub>2</sub>S EXPOSURE OF  
WORKERS IN SWINE BARN  
SASK PORK PROJECT #2002-02**

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**Objectives:**

Human exposure to high H<sub>2</sub>S concentrations is a very serious occupational health and safety issue. The main goal for the project is to develop systems that will prevent or reduce worker exposure to high H<sub>2</sub>S concentrations during manure handling in swine buildings. The specific objectives are:

Module 1:    To design and evaluate an improved pit plug concept that will allow for pit plugs to be opened from a remote location and that will assure that the plugs do not pop up because of pressure build up in sewer lines;

Module 2:    To measure H<sub>2</sub>S abatement when a water-based liquid is being sprayed over swine manure when it is being agitated (mimicking pit pulling events).

Start Date:       Module 1:    January - April 2002  
Completion Date:               April 2003

Start Date:       Module 2:    Start Date: September 2002  
Completion Date:               May - August 2003

Progress Reports:   April 2, 2003  
                          March 31, 2004 - FINAL REPORT\*  
                          \* Electronic Copy Available



## Summary of Results

Two engineering controls were developed to protect swine barn workers from exposure to hydrogen sulphide ( $H_2S$ ) gas during manure handling events. A remote manure pit plug pulling system was successfully developed, and testing in two grower-finisher swine rooms showed that the remote pulling system reduced worker exposure to  $H_2S$  by allowing the worker to pull the manure pit plug from outside the room.

A water sprinkling apparatus was also devised, which, under optimal operating conditions in a laboratory setting, resulted in a 79% reduction of  $H_2S$  gas concentration in the air above the water sprinkling system. However, the use of a similar system to reduce  $H_2S$  concentration in the airspace above the manure surface when manure was agitated in a 170-L barrel had the opposite effect. Hydrogen sulphide concentration in the airspace measured using a Draeger Pac III monitor actually increased when the water spraying system was in use. Further investigation revealed that the measurement of  $H_2S$  concentrations in the airspace above agitated manure with this particular monitor yielded results that were significantly larger than those obtained with other measurement methods.

### **Prototype Design**

Several plug designs were examined, including a balloon plug, sphere plug, extended cone plug and inverted plug. The selected solution, the extended cone plug, met the design criteria of low cost, ease of installation, safety, plug popping control and formation of a consistent seal. This design also minimized the flow restriction to the hole. A plug height stop was also designed to prevent the plug from coming out of the hole too far. With this plug height stop in place, if the plug is pulled or if it pops due to a build-up of pressure, the funnel-shaped extension on the plug will remain in the hole and guide the plug back into the hole and reform the seal.

The initial cost, operating cost and maintenance of the plug pulling system were the criteria used to choose among an air pressure system, electric motor apparatus and pulley system. The pulley system with optional winch was selected as the preferred method of mechanical plug pulling.

A prototype of the design was tested in a 170-L barrel that simulated 0.762 m of water head. The force required to pull the plug at four different water heads was measured and, using the developed linear regression equation, the force required to pull the 10.55 kg plug at a maximum manure depth of 1.22 m was estimated to be 630 N (142 lb). The occurrence of plug popping events was tested by introducing compressed air into a pipe below the plug. Air introduced into the tube leaked around the plug, preventing pressure build-up and plug popping. From the testing and design considerations, it was felt that if

the plug did pop due to pressure build-up, the plug height stop and extended cone design would immediately guide the plug back into the hole and reform the seal.

The design and testing stages were completed in December 2002. The design incorporated existing sewer lines and drainage holes in the floor of the pits, helping minimize the initial implementation costs. The pulling mechanism design allowed the two plugs in each pit to be pulled separately, allowing the worker to control which end of the manure pit is emptied.

**PROJECT: OPTIMIZING SPLIT WEANING PROTOCOLS FOR IMPROVED SOW  
FERTILITY AND WEANED PIG PRODUCTION  
SASK PORK PROJECT # 2002-01**

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**Objectives:**

1. The primary objective of this study will be to meet an urgent need in the production industry for improved split-weaning protocols that minimize depletion of sow body tissues, reduce the duration and variability in the weaning-to-estrus interval, and maximize litter size at next parity in first and second parity sows.
2. The second objective is to determine the effect of parity and split-weaning on piglet performance and weight variability by the end of the nursery period. The study will involve 160 first parity sows and their litters, for two consecutive lactation and gestation periods.

The research will provide information in the form of a recommendation to producers as to when to finally wean sows after split-weaning on day 14, or order to maximize reproductive performance after weaning. As well the research will provide technical information on the effects of parity and split-weaning on piglet growth performance and recommend to producers practices that may enhance growth performance of piglets.

Start Date: May 2002  
Completion Date: December 2003  
Progress Reports: April 23, 2003  
November 15, 2003  
July 6, 2005 - FINAL REPORT

**Summary of Results**

- 1) In sows returning to estrus in the normal breeding week after final weaning (designated as returning to first recorded post-weaning estrus on days 3 to 10 after weaning), there was no significant benefit from split-weaning, or of weaning on day 21 compared to day 16 of lactation, in terms of total born, born alive, stillborn, or mummies. Although no significant interaction between these two main effects of Split-

Weaning and lactation length were established with the number of replicates per treatment in this very controlled study, the difference of about 0.5 pigs born per litter in the SW 21 sows compared to the Control 21 group, might still be of economic importance in the industry if it is 1) reproducible, and 2), not associated with other management or production issues that would negate the financial benefits of the extra half as pig born live.

- 2) Differences in the percent of irregular weaning-to-estrus-intervals (WEI) were detected. Greater numbers of SW21 sows had irregular WEI, possibly indicating that SW21 sows may have been in heat whilst still in the farrowing. In the group of sows weaned conventionally on day 21, a problem of sows being in estrus on the day of, and days 1 and 2 after, weaning, and before rigorous heat checking was implemented is an issue. Other studies suggest that the fertility of first parity sows bred on the days immediately after weaning tends to be lower than in the succeeding days. Even in the absence of split-weaning, this expression of an immediate post-weaning estrus in even a small proportion of sows represents a source of variation in post-weaning fertility that should if possible be avoided. The situation in a small proportion of SW21 sows is even more extreme, with sows apparently coming in first estrus and ovulating before final weaning, as evidenced by the long, and irregular, return to first recorded estrus after final weaning. Again, although this trend probably relates to the very high reproductive merit of these sows, and a possible increase in litter size that will be achieved when these sows are bred at what is essentially a shortened "skip-a-heat" interval, the complications that this creates for breeding management programs is considerable. Use of pharmacological aids such as an oral progestagen, to block the onset of estrus during lactation and until at least day 3 after weaning, may be beneficial if split-weaning is to find application in modern sow management programs. This would allow producers to gain the benefits of split-weaning but still breed weaned sows in a synchronous breeding group after final weaning.
- 3) There was no detected difference in sow body weights between treatments, indicating that in the population of sows studied there was no major advantage to the sow in terms of reducing the negative energy balance that frequently occurs in the last week of a 21-day lactation in first parity female. Larger-scale studies suggest, however, that in the sub-population of 10 to 15% of sows with low voluntary feed intake, split-weaning may still provide some protection against severe catabolism, and against negative impacts on litter growth after day 14 of lactation. Split-weaning of Parity 1 sows had no subsequent consequences for second parity body weight of sows at farrowing or weaning.
- 4) Although conception rate in SW21 sows appeared to be lower, no statistically significant differences among treatments were established.

- 5) Split-weaning had an effect on piglet weight and average daily gain. Numerically piglets weaned at D21, irrespective of whether they were split-weaned or not, were heavier and grew faster than piglets weaned at D16. Piglets that were split-weaned had lower body weights and lower average daily gains in the nursery than the piglets that were not split-weaned. This is assumed to relate to the relative immaturity of the gut in the pigs weaned as early as day 14 of lactation. Although this might be compensated by more complex and digestible diets, the cost of such feeds would probably reduce net profitability, given the lack of any major advantages in overall fertility and productivity of split-weaned sows.

**PROJECT: DEVELOPMENT OF SYNTHETIC EXTENDERS FOR  
CRYOPRESERVATION OF BOAR AND BULL SEMEN  
SASK PORK PROJECT # 2001-18**

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**Objectives:**

1. To develop synthetic extenders (not requiring egg yolk and milk) for the cryopreservation of boar and bull semen, and
2. To generate basic knowledge that will result in higher and more consistent sperm survival rates than is presently possible.

Current procedures for the cryopreservation of bull and boar spermatozoa utilize egg yolk/milk in buffered extender solutions containing glycerol. The potential transmission of *Salmonella* species or the Newcastle Disease virus with egg yolk provides a strong argument of the elimination of egg yolk from semen cryopreservation procedures. Similarly, foreign diseases such as Foot and Mouth Disease may be spread in semen extenders when milk is used.

Start Date: 2002  
Completion Date: 2005  
Progress Reports: December 29, 2002  
May 7, 2003  
March 2004  
December 8, 2004  
October 31, 2005

## Summary of Results

In 2002, this project received additional financial support from two additional industry sponsors, Bioniche Animal Health, Bellville, Ontario and Boviteq, Ste. Hyacinthe, Quebec. Since that time, Bioniche Animal Health has become a commercial partner on the project.

Support from ADF, Agri-Food Innovation Fund and Sask Pork has allowed this project to move towards development of commercial bovine and porcine synthetic (without animal proteins) extenders for:

- the crypreservation of bovine semen;
- the preservation (short and long term) of porcine semen in liquid form;
- the crypreservation of porcine semen.

In March 2005 a Research Collaboration Agreement was signed between all participants. This Agreement sets the stage for the full development of both synthetic extenders. A joint steering committee was formed to oversee and manage the general progress of the project.



PROJECT: QUANTIFYING N<sub>2</sub>O FLUXES ASSOCIATED WITH AGRICULTURAL  
PRACTICES  
SASK PORK PROJECT #2001-15

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This project is complementary to Dr. Claude Lague (Greenhouse Gas and Odour Emissions from Swine Operations in Quebec and Saskatchewan: Benchmark Assessments). The project will estimate N<sub>2</sub>O flux associated with agricultural practices common to the Canadian prairies. Few attempts have been made to directly compare N<sub>2</sub>O fluxes from different land usages. The agricultural practices examined will include: conventional cropping, reduced-tillage, forage legume production, and pasture grass production. An unfertilized wheat/fallow rotation will also be included.

A distinctive feature of this research is that it will focus on improving our estimates of N<sub>2</sub>O fluxes from the hummocky (i.e., non-level) landscapes characteristic of the prairie provinces. A second unique feature of this research is that it will compare N<sub>2</sub>O flux estimates associated with the land application of hog manure to those associated with the use of conventional (i.e., chemical) fertilizers. This research builds on the existing efforts of scientists at the University of Saskatchewan to understand soil processes at the landscape-scale and model N<sub>2</sub>O fluxes associated with manure applications. The proposed research will provide critical data for both the evaluation of agricultural practices on N<sub>2</sub>O emissions and the development of an emission factor for hog manure that is pertinent to western Canadian agriculture.

Start Date: 2002  
Completion Date: 2003  
Progress Reports: December 9, 2003 - FINAL REPORT\*  
\* Electronic Copy Available



## Summary of Results

To date, few attempts have been made to directly compare  $\text{N}_2\text{O}$  fluxes from different land usages. Thus, this project was conceived and carried out to assess the magnitude of  $\text{N}_2\text{O}$  emissions associated with the agricultural practices prevailing on the Canadian prairies. Agricultural practices examined included: conventional cropping, minimum- or reduced-tillage, forage legume production, and an unfertilized wheat/fallow rotation. A distinctive feature of this research was its focus on improving our estimates of  $\text{N}_2\text{O}$  fluxes from the hummocky (i.e. non-level) landscapes characteristic of the prairie provinces. Urea fertilizer and liquid swine manure were used as N sources. Nitrous oxide fluxes were obtained using non-steady state, vented chambers and were upscaled using a "measure and multiply" approach to (i) yield estimates of the total  $\text{N}_2\text{O}$ -N flux and (ii) calculate emission factors for the urea and liquid swine manure.

Weather at the research site was characterized by extreme drought, which lasted throughout much of the 2-1/2 year study period. Soil moisture was frequently limiting and, as a result,  $\text{N}_2\text{O}$  and interquartile ranges from 0 to ca.  $105 \text{ ng N m}^{-2} \text{ x}^{-1}$ . Despite the low flux values, however, there were significant landscape, management and fertilizer-N effects.

Nitrous oxide fluxes increased in the sequence: upper slopes < backslopes  $\leq$  lower slopes. This trend remained consistent regardless of the magnitude of the flux, and non-zero median fluxes were recorded more frequently in the footslopes than in either the shoulder or backslope positions. Likewise, treatment (i.e., management and N-fertilizer) effects on the  $\text{N}_2\text{O}$  flux were almost always greater in the footslopes.

Management (tillage) effects on  $\text{N}_2\text{O}$  emissions were observed in both years of the study. Emissions were generally higher from the conventional tillage (CT) plots than from the minimum tillage (MT) plots and from the cropped (wheat or barley) plots than from the forage/pasture plots. Whereas N source had not significant effect on  $\text{N}_2\text{O}$  emissions, emissions from the fertilized plots were significantly greater than those from the unfertilized (CCF) plots. Likewise,  $\text{N}_2\text{O}$  emissions from the unfertilized, inoculated alfalfa stands were lower than those from the fertilized stands. For both the urea and manure, increase the N-application rate also resulted in increased  $\text{N}_2\text{O}$  emissions. However, within the range of application rates used in this study ( $60\text{-}120\text{-kg urea-N ha}^{-1}$  and  $53\text{-} \& 106\text{-kg manure-N ha}^{-1}$ ), the calculated emissions factors for both urea and manure were essentially independent of N-application rate. Emission factors for urea (0.21%) and manure (0.21%) were well below the 1.25% emission factor proposed by the Intergovernmental Panel on Climate Change (IPCC). Even taking this into consideration the relatively conservative nature of our estimates, we believe these results indicate a clear need to develop fertilizer-N emission factors that are more representative of regional differences that exist in Canadian agriculture.

**PROJECT: FEASIBILITY OF RENOVATING EXISTING FACILITIES TO  
ACCOMMODATE LARGE GROUP MANAGEMENT FOR GROW/FINISH  
PIGS  
SASK PORK PROJECT #2001-13**

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A recent development in grow/finish management is the use of large group sizes, in the range of 100-500 pigs per pen. This systems results in reduced capital costs at the time of construction and reduced labour for cleaning. There is the potential for reduced labor for sorting if in-pen sorting scales are used. Production results are promising, with few examples of reduced gain or greater variability in body weights. New facilities can be designed specifically for large group management systems, but renovation of existing facilities may be more difficult. Of particular interest is the renovation of partially slatted barns in which dunging patterns may need to be managed.

This project will examine the costs and benefits of removing an existing facility to accommodate large groups. Objectives are:

1. To assess the costs of renovating an existing facility to accommodate large group grow/finish.
2. To assess the productivity of pigs in the renovated facility, including growth rate, variation in body weights at market, and incidence of health problems.
3. To assess the savings in labour for sorting pigs with an automate systems and for cleaning the rooms between turns.

Start Date: December 15, 2001  
Completion Date: December 15, 2002  
Progress Reports: January 2003 - FINAL REPORT

## Summary of Results

This project was conducted to study the feasibility of renovating partially slatted grower and finisher rooms to accommodate large groups of pigs (250 per pen). The facility used included separate grower and finisher rooms. Four weekly weanings were allotted to each of conventional sized groups (approximately 22 pigs/pen) and large groups (250 pigs/group). The productivity of the pigs in large and small groups, based on average daily gain (857 vs 891 g/day for large and small groups, respectively), variability in final body weight (12.5 vs 11.0 % c.v.), and animal losses (4.3 vs 4.3 %), did not differ significantly. The numerical difference of 34 g/day in average daily gain represented a reduction of less than 4% in the large groups. It is likely that additional improvements in management and facility design could eliminate all production differences.

The time required for daily health checks and cleaning was greater for large groups (358 vs 254 min/cycle), but this was due to an increased requirement for scraping (135 vs 30 min/cycle). This increase may not apply to the renovation of fully slatted facilities. The amount of time required to powerwash large and small group rooms did not differ on average (490 min/room), but varied considerably in the large group rooms (270 to 710 min). The caking of manure on the solid floor varied considerably among large group rooms and affected cleaning time. The layout of the large group rooms for sorting by means of an electronic scale proved to be inefficient. Additional renovations would be required to make use of such a system on a commercial basis.

**PROJECT: VIDO SWINE TECHNICAL GROUP  
SASK PORK PROJECT #2001-11**

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The **VIDO Swine Technical Group** is a volunteer group of people directly involved in the swine industry and include producers, veterinarians, agricultural economists, agricultural engineers, nutritionists, farm extension workers and VIDO research scientists.

The group investigates and discusses diseases plus one or two staff members from VIDO that are given free reign to pursue timely issues of interest to hog producers. Members are from Ontario, the three prairie provinces, and B.C. and include producers, agricultural engineers, veterinarians, swine nutritionists and a bacteriologist. In addition to publishing articles, papers and preparing an extensive manual on swine production and management, they are also available to speak at producers meetings.

Start Date: December 2001  
Completion Date: December 2004  
Progress Reports: March 2004  
June 23, 2004

Information on the activities of the VIDO Swine Technical Group can be found at:  
<http://www.vido.org/pdf/VIDO%20technical%20groups.pdf> or  
<http://www.vido.org/producers/techgroups/swine/index.php>

**PROJECT: MONITORING LONG TERM EFFECTS OF REPEATED SWINE MANURE APPLICATIONS ON CROP PRODUCTION, SOIL AND ENVIRONMENTAL QUALITY IN SASKATCHEWAN  
SASK PORK PROJECT #2001-10**

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This proposal was developed in response to a need to establish long term monitoring research sites as identified by the Sask Pork Research Committee. Four key sites have been selected for long term monitoring: Riverhurst, Plenty, Dixon, Melfort.

Over the past five years, field plots have been established across the soil climatic zones of Saskatchewan to examine the effects of different rates, method and sequence of swine manure application on soil fertility and microbiology, physical and chemical soil conditions, crop growth and quality. To this point the research has focused on short term (1-5 years) effects of swine manure application strategies. Long term monitoring of these sites will provide information to develop sound guidelines for management of manured lands and back this up with research data pertinent to Saskatchewan soils and cropping systems.

|                   |                              |
|-------------------|------------------------------|
| Start Date:       | 2003 Field Season            |
| Completion Date:  | 2005 Field Season            |
| Progress Reports: | January 22, 2003             |
|                   | July 2003                    |
|                   | December 31, 2003            |
|                   | June, 2004                   |
|                   | December 2004 - FINAL REPORT |



## Summary of Results

After five to eight years of manure application at four SK sites (Dixon, Melfort, Plenty and Riverhurst) using different rates, sequences and methods of application, the results indicate that manure that is applied at rates that are in balance with crop removal and uptake over time is a sustainable management practice. In-soil placement of liquid swine manure by injection produces superior crop yield and nutrient recovery compared to surface application while minimizing odors. Additions of swine manure equivalent to about 100 lbs N/acre annually is capable of maximizing crop production with no apparent excess nutrient accumulation, toxicity or losses. Larger single applications made once every second or third year also do not appear to be associated with nutrient loading or large migration of nutrients out of the soil profile, but risk of nutrient loss or crop injury is greater in the year of application with a single high rate and the residual effects appear to have diminished significantly by the third year. Large additions made every year, e.g. 10,000 plus gallons per acre per year, result in excessive accumulations of nitrate and evidence of leaching below the rooting zone, as well as build-up of labile, potentially mobile phosphorus. For cattle manure, the build-up of excessive nitrates at high rates of application after eight years was not apparent, reflecting the slow release of available N from the organic N forms in the manure. However, labile soil phosphorus was found to increase more rapidly in the cattle manure treatments than in swine manured soils and should be monitored closely.

As manure often does not have the appropriate balance of available nutrients required by plants, there can be benefits from supplementing manure with commercial fertilizer application. Nutrient balances, especially N:S and N:P following manure application must be considered. No response to supplemental P fertilization was observed in the trials at Dixon in 2003 despite low amounts of P added as manure, but responses were observed in 2004 on the agronomic rate treatments. Application of low P content swine manure at agronomic rates to supply N to crops could show response to additional fertilizer P for some crops in some years. However, this would not be the case where manure was applied at high rates as there is evidence for P build-up when swine manure is over-applied. Substantial responses to S fertilizer applied in 2002 were observed with canola in 2003 on manured plots on a sulfur-deficient soil at Melfort, but no responses were observed with oats in 2004, likely due to the diminished residual effect of the sulfur fertilizer application in 2002. Special attention should be given to sulfur when growing crops on S deficient soils that have received high rates of swine manure in the past, as nitrogen may carryover into subsequent years but the sulfur added as manure may have been all used up by the crop in the year of application. Residual effects of manure applications made in past years on increasing availability of nutrients in the current year are very apparent, especially with cattle manure. These residual effects should be taken into consideration in manure nutrient management planning.

Applications of manure increased nitrogen, phosphorus and sulfur concentrations and uptake by the crops grown. In general, the cereal and oilseed crops grown in 2003 and 2004: wheat, canola, oats responded well to manure application in increased yield and protein content. The combination of manure with additional commercial fertilizer applied appeared to result in some reductions in potato tuber yield in irrigated potatoes that may be associated with excess nitrogen and should be explored further. Canary seed yield was not as responsive to manure as the other crops. At the Plenty site, accumulations of nutrient in the soil were highest, reflecting three years of low yield due to drought and insect accumulations. These results indicate the importance of matching manure nutrient application rate to crop growth and nutrient removal potential.

After five to eight years of repeated manure application, the accumulation of trace metals in the manured soils appears to be limited to some relatively small increases in labile copper and zinc. There was no evidence for accumulation or toxicity of non-functional trace metals like mercury or arsenic in soils or plants.

In the field, early crop growth and development was not significantly influenced by a history of repeated annual applications of swine manure, especially at agronomic rates. However, care must be taken when seeding crops into soils that have received high rates of liquid manure that year and in which there has been limited leaching, as salts and ammonium from the manure may be present in the seeding zone that could interfere with germination and early plant development, especially under dry conditions.

Soils from the trials with a history of five to eight annual manure applications showed no apparent increases in salinity or sodicity associated with the manure applications at either low or high rates. Consistent with this was the observation that surface crusting was either not affected or reduced with manure application and that water infiltration was not affected or sometimes increased in the manured soils. In general, repeated manure application at agronomic rates was found to have no detrimental impact on early crop growth or soil physical properties.

Increases in soil organic matter content associated with five to eight years of annual swine manure additions are not large, and are mainly related to enhanced crop growth and residue input, that shows up as increased light fraction organic carbon. Compared to solid manures, liquid swine manure adds relatively little organic matter directly. As the nutrients will stimulate microbial activity and enhance decomposition, there may a counteracting effect and it may take many years before significant increases are observed. Manure applications at agronomic rates generally had no impact on microbial enzyme activity or else they increased enzyme activity in the soil that would contribute to higher rates of nutrient recycling.

In general, the application of manure fertilizer increases the plant availability of some of the metals and has no effect on others. AB-DTPA extractable soil fractions and/or plant tissue content of copper, zinc, and cadmium may increase significantly with increasing manure or N fertilizer rates, but the increases are not large. Selenium, arsenic, and mercury plant availability generally remain unchanged by increasing manure fertilizer rates. Manure does not appear to enhance soil crust formation or interfere with emergence and early plant development, nor is it associated with significant increases in salinity, sodicity or soil strength. Repeated additions of swine manure had variable effects on soil organic carbon in surface soils. Soils low in soil organic matter and of high clay content showed large, significant increases while soils high in organic matter did not show a significant effect. In some soils urea or swine manure addition may enhance the decomposition of soil organic matter. Increases in organic matter with cattle manure addition are attributed to direct addition of organic matter in manure. Increases in light fraction organic matter act as substrate for microorganisms to convert into stable humus.

Overall, it is concluded that annual applications of manure made for five to eight years on these soils at agronomic rates in balance with crop nutrient removal greatly enhanced crop production while maintaining or improving soil and environmental quality.



**PROJECT: HYDROGEN SULPHIDE (H<sub>2</sub>S) RISKS ASSESSMENT FOR THE  
SASKATCHEWAN SWINE INDUSTRY  
SASK PORK PROJECT #2001-07**

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Hydrogen Sulphide (H<sub>2</sub>S) is a life-threatening gas that is produced by the anaerobic degradation of liquid manure. This gas is released during manure management tasks performed inside or outside the building. While high concentrations of hydrogen sulphide can result in death, lower concentrations can cause long-term damages that are not well known and documented in the swine industry. As long as liquid swine manure is not removed, H<sub>2</sub>S is always found in very low concentration in barns. However, the H<sub>2</sub>S concentration can rise very quickly when a plug is being pulled or the manure agitated in any way.

The objective is to assess the risks, providing the industry with a good picture of the current situation and identify possible solutions to control or eliminate workers' exposure to this hazard

Start Date: May 2001  
Completion Date: December 2001  
Progress Reports: July 4, 2002 - FINAL REPORT

### Summary of Results

In both intensive and diversified swine operations, barn workers can be exposed to hydrogen sulphide (H<sub>2</sub>S) at different levels. Those exposures and their impacts on workers' health are not well known and documented in the swine industry. Deadly incidents related to H<sub>2</sub>S exposure occurred in Saskatchewan and elsewhere in Canada and those incidents have raised government and public awareness (Saskatchewan Labour, 2000; Canada Plan Service, 1985). Those incidents lead us to believe that swine workers may be at risks within the scope of their normal activities particularly while performing manure management tasks.

Having identified these risks and issues, a committee formed by industry members has been meeting to try to find answers and solutions to the problems and preoccupations associated with H<sub>2</sub>S and manure management in swine buildings. The project on "Hydrogen Sulphide Risks Assessment for the Saskatchewan Swine Industry" was thus put together by Prairie Swine Centre Inc. (PSCI) to help assessing the situation as a first step into finding sustainable solutions to the risks associated with manure management tasks and H<sub>2</sub>S. Some members of the committee were invited by the research team to collaborate to the project by doing some monitoring in their barns.

The project was completed to assess the risks associated with H<sub>2</sub>S exposure and manure management tasks performed routinely on swine farms. An exhaustive literature review on H<sub>2</sub>S, the chemistry around its production and release in the manure, and also on the health hazards it presents to humans was performed. Further to that, monitoring was realized to assess the H<sub>2</sub>S concentrations in the workers' environment during completion of specific manure management tasks: 1. emptying manure pits in swine barns; 2. power washing of production rooms; 3. working around the lift station and, 4. agitation and emptying of manure storage facilities outside the barns.

In livestock production, hydrogen sulphide gas is mostly produced through the degradation of liquid manure stored in anaerobic conditions. Agitation of this slurry will usually release H<sub>2</sub>S in variable amounts. This gas is heavier than air so it will lay low and, if not exhausted, will stay trapped in confined spaces. Persons exposed to H<sub>2</sub>S receive poor warning signals as its characteristic odour of rotten eggs is detected only at lower concentrations (generally less than 20 ppm). Exposure to H<sub>2</sub>S at low level will cause eyes and mucosa irritation. As the concentration increases, symptoms such as headache, dizziness, nausea, vomiting, pulmonary edema will be experienced. Workers who are unaware of exposition to H<sub>2</sub>S within the scope of their normal tasks can experience such symptoms and then go home feeling off colour, thinking that they just had a bad day. More severe exposure can result in knockdowns, respiratory arrest and death. Not everybody reacts similarly to H<sub>2</sub>S exposure and this contaminant may trigger long term reactions such as RADS (reactive airways dysfunction syndrome). The gravity of the sequelae from H<sub>2</sub>S exposure is closely linked with the concentration reached, the exposure and response time to rescue the victim and to provide him or her with proper medical care. Education, monitoring and training are key elements to insure the safety of workers as well, proper procedures and safety equipment have also to be made available to the workers.

Plug pulling can generate very high concentrations of H<sub>2</sub>S. The maximum values recorded during some of the monitored events reached 1,000 ppm (which was the maximum detectable concentration for the sensors used in this study). On all the six farms where the monitoring has been performed, plug pulling events that could present health and safety risks to workers and exceeded limits defined by the Occupational and Safety Regulations of Saskatchewan were encountered (Saskatchewan Labour, 1996). Those limits are a maximum concentrations of 100 ppm or more, and a time weighted average over a 15-minute period exceeding 15 ppm (STEL). Farms that have a water source rich in sulphate are more at risks for high H<sub>2</sub>S concentration being released in their swine buildings. The H<sub>2</sub>S released as a plug is being pulled does not follow a predictable pattern when considering the level that will be reached, the concentration variations during the event and the time at which the peak concentration will be observed. Some events of plug popping (plug being displaced from the sewer hole allowing for manure or gas backflow) in other parts of the barn have been observed during the study. Such events can result in workers being exposed to H<sub>2</sub>S while feeling safe and because they are away from the area where a pit is being pulled. This situation questions a trend that is often observed in the barns and where only the worker performing manure management tasks is provided with a H<sub>2</sub>S monitor. All workers should be provided with a H<sub>2</sub>S monitor to insure that danger is known when the H<sub>2</sub>S concentration arises. As well, engineering controls have to be developed to prevent H<sub>2</sub>S formation in the manure or H<sub>2</sub>S emission into the worker/pig space.

The concentration distribution in a room while the plug is being pulled does not follow a predictable pattern and no systematic preferred location where the peak would be reached could be identified. While most of the highest concentrations were generally recorded at the plug or sewer hole, in some cases it was recorded somewhere else in the room or over the pit.

This means that a worker pulling the plug than walking away from the plug may not go to a safer area if he stays in the room; the same comment apply to a bystander staying in the room.

Power washing generated lower hydrogen sulphide concentrations than plug pulling. However, as the task to be performed generally takes time, the STEL can be reached a while after the task started (close or more than an hour after the start) and exceeded the STEL for a long period of time, which for some of the monitored events, was more than 30 min. Monitoring for this task is also critical and if no engineering controls other than normal ventilation are available to maintain the concentration at a low level, more time should be allowed for the washes so workers can vacate the contaminated area and come back only when the ventilation system has brought the  $H_2S$  concentration down.

Finally, the results from this study showed that the risks of exposure to excessive  $H_2S$  concentrations during the agitation and emptying of outside manure storage facilities are very limited. The highest  $H_2S$  concentrations were measured directly above the manure storage facilities and never exceeded 25 ppm. The 15-ppm threshold value for a 15-minute exposure was never exceeded at any location (i.e. above the storage facility, downwind from it or at the location where the agitation and emptying equipment is operating).

**PROJECT: IMPACT OF SWINE MANURE ADDITIONS ON SOIL METALS AND  
THEIR INTERACTION WITH ORGANIC MATTER  
SASK PORK PROJECT #2001-02**

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Sask Pork has committed funds for the 2001 and 2002 growing season (Sask Pork Project #2000-09) for the project "*Manure as a Sustainable Source of Plant Nutrients.*" to continue the swine manure field trials at Dixon, Saskatchewan that were started in 1997 under AFIF funding. The project monitors the effect of repeated manure applications on agronomic properties, including soil nutrients, crop yield nutrient uptake.

The proposed work in this project involves the collection of soil from the annually cropped field plots at the Dixon site which have received five applications of swine manure at low and high rates, as well as soils from the long-term AFIF Low Disturbance Injection of Swine Effluent into Forages plot at Burr, Saskatchewan (brome-alfalfa stand) which has three repeated applications of swine effluent.

The anticipated outcome of the research is to determine how long-term application of swine manure influences micronutrient metal amounts and behavior and its relationship to soil organic matter properties. This will enable adjustments to be made in feed supplements and additives to address possible metal loading concerns as well as adjustments in rate of manure application and/or use of supplemental micronutrient fertilizers in manured soils.

Start Date: Spring 2001  
Completion Date: Summer 2002  
Progress Reports: April 3, 2002  
November 18, 2002 - FINAL REPORT\*  
\* Electronic Copy Available

## Summary of Results

Objective: To determine how repeated applications of liquid swine manure affect the amounts and distribution of copper and zinc in Saskatchewan soils, with emphasis on their interaction with soil organic matter and other soil constituents.

Background: The fate of micronutrient metals added as liquid swine manure is poorly understood in Western Canadian soils. The high amounts of organic matter and calcareous parent material of our soils makes extrapolation of research results obtained in other jurisdictions such as Europe difficult. There is potential for micronutrient metals such as copper and zinc to undergo different fates in our soils as compared to more highly weathered, acidic soils. The interaction with organic matter is likely to be important as is fixation with carbonates and hydroxides to form insoluble precipitates. For this reason, the impact of repeated applications on our soils needed to be investigated.

Activities and Observations: *See attached scientific paper manuscript for details. A general description follows:*

- Sampling (0-15cm) of field manure research sites in spring and fall of 2001 at Dixon annual crop and Burr brome-alfalfa and Lanigan russian wild-ryegrass swine manure research sites in east-central Saskatchewan.
- In 2002, soil sample processing and sequential extraction of seven copper and zinc fractions from each soil sample, including exchangeable, adsorbed, organic matter associated, oxide associated and mineral bound. Determination of total copper and zinc, and DTPA (soil test) copper and zinc and organic matter fractions.
- Results will be presented at 2003 Soils and Crops Workshop conference, February 2003, University of Saskatchewan. A scientific paper on the results has been constructed and submitted to Canadian Journal of Soil Science this fall.

Results and Discussion: *See attached scientific paper manuscript for all data in tables and statistical analyses. A general summary follows:*

- About 50% of the copper in the soils was present as copper bound in primary silicate minerals originating from the parent material. The next largest fraction was copper associated with organic matter, representing about 25% of copper in the soil. Additions of swine manure only produced significant increases in the oxide associated copper and the DTPA (soil test) copper and the increases were relatively small (~0.5 to 2 ppm). In the case of zinc, 80 to 90% of the zinc was associated with primary minerals. Addition of swine manure produced significant increases mainly in the adsorbed zinc fractions and in the DTPA (soil test) zinc. Similar to copper, the increases in these fractions were small,



with manure additions at the highest rate raising the soil test and adsorbed fractions only by about 0.5 to 2 ppm.

- Overall, increases in total soil copper and zinc with manure application were small, and generally only small increases in the labile, available fractions in the soil were observed. The limited effect of repeated swine manure applications on total and available copper and zinc after five years is consistent with the relatively low amounts of copper and zinc that were calculated to be added to the soil each year with manure application: 0.2 to 0.8 kg per ha per year. These amounts appear to be relatively in balance with crop removal over the five years. It is concluded that at normal agronomic rates of swine manure application, neither large accumulations nor depletions of copper and zinc would be anticipated over time, based on the results of this study.

- Additions of swine manure increase the light fraction of soil organic matter, reflecting mainly recent organic matter additions from stimulated plant production by the manure nutrients. It is anticipated that this recent organic matter input would have the role of increasing the amount of micronutrient metal that is associated with organic matter in the soil. A trend towards increased amount of copper and zinc associated with organic matter was observed in the swine manure amended soils, but the increases were small and often not statistically significant. Increases in available Zn were less in the grassland trial soils than in the annual cropping trials, due to lower application rates and only three years of application versus five in the annual cropping plots. Higher contents of light fraction organic matter in the grassland soils suggest a greater potential for binding and retaining metals in the organic form in these and similar soils.

### Conclusions:

Loading of the soil with the micronutrient metals copper and zinc from application of swine manure for three to five years does not appear to be a major concern, based on the results of this study which showed relatively little impact on the total and bioavailable contents of soil copper and zinc, even at high manure application rates for this duration of application. However, the content of copper and zinc in manure is variable and depends to a large extent on feed ration formulation, which varies from operation to operation. The content of micronutrient in soils receiving repeated applications of manure should be monitored to determine not only possible undesirable increases in copper and zinc, but also depletion of soil reserves through crop uptake and removal if content of micronutrient in manure is very low. Repeated applications of high metal manure for several years may be of concern due to eventual saturation of metal binding sites in the soil, leading to more of the manure metal accumulating in more soluble forms.



**PROJECT: GREENHOUSE GAS AND ODOUR EMISSIONS FROM SWINE  
OPERATIONS IN QUEBEC AND SASKATCHEWAN:  
BENCHMARK ASSESSMENTS  
SASK PORK PROJECT #2000-14**

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This research project focuses on the assessment of benchmark values for greenhouse gas (GHG) and odour emissions from swine production buildings and manure storage facilities in Quebec and Saskatchewan. This information is required in order to more precisely assess the absolute and relative contributions of these two important stages of the pork production industry to the general emissions of GHG in Canada.

Agriculture as a whole could account for 9.5% of the total Canadian greenhouse gas (GHG) emissions, with  $N_2O$  and  $CH_4$  contributing 61% and 38% respectively. It is also estimated that 42% of the agricultural GHG emissions originate from livestock operations and one third of these are associated with manure management. There exists a need to better determine the relative contributions of the different stages of livestock production and manure management to the GHG emissions caused by this agricultural sector. Another important emission issue for livestock operations, particularly in swine production, is odours.

The general objective of the proposed research is to evaluate GHG ( $CH_4$ ,  $CO_2$  and  $N_2O$ ) and odours emissions for swine operations in the two provinces under liquid manure management.

Start Date: January 1, 2001  
Completion Date: September 30, 2003  
Progress Reports: March 7, 2002  
March 2003  
December 10, 2003  
February 17, 2004 - FINAL REPORT

## Summary of Results

Agriculture as a whole could account for 9.5% of the total Canadian greenhouse gas (GHG) emissions. It is also estimated that 42% of the agricultural GHG emissions originate from livestock operations and one third of these are associated with manure management. There exists a need to better determine the relative contributions of the different stages of livestock production and manure management to the GHG emissions caused by this agricultural sector. Another important emission issue for livestock operations, particularly in swine production, is odours. As for GHG emissions, there is a need to better assess the effects of the different components of livestock operations (animal housing and diet, manure management) on the overall operation emissions.

The general objective of this study was to evaluate methane ( $\text{CH}_4$ ), carbon dioxide ( $\text{CO}_2$ ) and nitrous oxide ( $\text{N}_2\text{O}$ ) emissions, and also odours emissions for swine operations in two provinces (Québec and Saskatchewan) under liquid manure management. More specifically, the research has been targeted at: 1. determining GHG and odour emissions from different types of swine production buildings and building floor designs; 2. determining GHG and odour emissions from different types of manure storage facilities, and 3. determining GHG and odour emissions from two manure treatment systems. Greenhouse gas and odour emission results have been expressed in terms of unit animal mass in order to allow for direct comparisons between the different sources. Researchers from four different organizations - the Institut de recherche et développement en agroenvironnement (IRDA), Prairie Swine Centre Inc. (PSCI), Université Laval and the University of Saskatchewan - actively participated in the project.

Greenhouse gas emissions (all values expressed in g of  $\text{CO}_2$ -equivalent per day per kg of animal mass)

Carbon dioxide emissions were the most important contributor to GHG emissions from swine buildings, ranging from 21.0 to 144.5. On a mass basis,  $\text{CH}_4$  emissions were much lower than  $\text{CO}_2$  emissions ranging from 0.07 to 1.96 g/day-kg<sub>pig</sub>. Nitrous oxide production was practically negligible. The lowest  $\text{CO}_2$  production was measured in gestation rooms while the largest emissions occurred in grower-finisher rooms. The floor design did not affect  $\text{CO}_2$  production. However, the  $\text{CH}_4$  production rate was higher with the fully slatted floor room (0.43) than with the partially slatted floor room (0.24).

Greenhouse gas emissions from different types of manure storage facilities (i.e. earthen manure storage basins (EMB) uncovered or covered with blown chopped straw; concrete storage tanks) were measured during the 2001, 2002 and 2003 seasons in Saskatchewan. Average (range) GHG emissions from manure storage facilities were as follows: 2.41 (0 to 25.00) for methane; 0.94 (0 to 7.00) for carbon dioxide and, <0.01 for nitrous oxide. Average total GHG emissions from uncovered EMB, covered EMB and uncovered tank

storage facilities measured in this study were 4.23, 2.52 and 6.65 respectively. Average total GHG emissions from EMB primary cells measured in this study were 1.90 (uncovered) and 1.41 (covered) while corresponding values for EMB secondary cells were 10.08 and 1.46 respectively. These two series of results confirm the positive impacts of blown chopped straw covers on GHG emissions from manure storage facilities. Average total GHG emissions during the spring, summer and fall seasons respectively amounted to 0.47, 3.91 and 3.49. Finally, average total GHG emissions during the daytime (between 06:00 and 18:00) and night (between 18:00 and 06:00) periods, as measured in this study, were 9.35 and 13.92 respectively.

Greenhouse gas emissions from a concrete tank manure storage facilities were monitored during the 2001, 2002 and 2003 seasons in Québec. Average GHG emissions were as follows: 10.81 (1 to 40) for methane and 1.03 (0.1 to 4) for carbon dioxide. Nitrous oxide emissions were found to be negligible. Greenhouse gas emissions were not affected by the depth of manure in the storage facility. Similarly, no diurnal/nocturnal effects on GHG emissions could be determined from the experimental results. However, summertime methane and carbon dioxide emissions were respectively ten and five times more important than those observed during the fall.

Greenhouse gas emissions from an aerobic-anoxic manure treatment system were monitored during the 2002 and 2003 seasons. Average GHG emissions were as follows: 0.77 for methane, 2.39 for carbon dioxide and 0.38 for nitrous oxide. No diurnal/nocturnal or seasonal effects on GHG emissions were detected. However, treatment phases (aerobic or anoxic) did influence GHG emissions. Carbon dioxide emissions were more important during the aerobic phase while nitrous oxide and methane emissions were more important during the anoxic phase. Greenhouse gas emissions from a biofilter manure treatment system were monitored during the 2002 and 2003 seasons. Average (and range) GHG emissions were as follows: 1.05 (0 to 3.59) for methane, 0.87 (0 to 3.35) for carbon dioxide and 5.63 (0.13 to 35.79) for nitrous oxide.

A preliminary assessment completed on the basis of the experimental results obtained in this study suggests that both the aerobic-anoxic and biofilter manure treatment systems have the potential to reduce overall methane emissions from swine production systems. However, they have the opposite effect for nitrous oxide emissions. In addition, GHG emissions associated with the storage and composting of the separated solid fraction of the treated manure would need to be included in order to fully assess the effectiveness of these two technologies at reducing GHG emissions from swine production systems. Conventional production systems consisting of production buildings and long term outdoor manure storage facilities would produce between 12 and 20 g CO<sub>2</sub>-equivalent per day per kg of animal mass of methane with the bulk of it originating from the production buildings. Similarly, most of the nitrous oxide emitted by conventional swine production systems originates from the production buildings. This would suggest that production buildings

should be the primary target for mitigation measures aimed at reducing both methane and nitrous oxide emissions.

#### Odour emissions

The various types of rooms in these buildings emitted between 2.1 and 7.3 O.U./s-m<sup>2</sup>. Odour emissions from farrowing and gestation rooms were fairly similar at both sites. Emissions from the nursery were slightly different but the floor space allowance and the room design were not the same. Grower-finisher rooms at site 2 produced approximately three times more odour on a square meter basis than the grower-finisher room at site 1. Nursery pigs in site 1 produced the highest odour emission with 7.3 O.U./s-m<sup>2</sup> followed by the grower-finisher rooms of site 2 at 6.2 and 7.1 O.U./s-m<sup>2</sup>. The nursery room of site 1 is based on an older design where more manure accumulates on the floor compared to the nursery room at site 2. However, the gestation room produced the most important odour emissions. On a site basis, considering the number of grower-finisher rooms required with a farrow-to-finish production system, these rooms constituted the largest source of odours.

Odour emissions from three types of manure storage facilities (uncovered and covered EMB, uncovered concrete tank) were measured in Saskatchewan during the 2001, 2002 and 2003 seasons. All experimental data has been expressed in terms of odour units (O.U.) per second per kg of animal mass. Average odour emissions from all types of manure storage facilities during those three seasons were 0.0342 (in 2001), 0.0224 (in 2002) and 0.0362 (in 2003). Average odour emissions from covered EMB, uncovered EMB and uncovered tank storage facilities were respectively 0.0208, 0.0335 and 0.0481. Average odour emissions from EMB primary cells measured in this study were 0.0265 (uncovered) and 0.0089 (covered by chopped straw) while corresponding values for EMB secondary cells were 0.0481 and 0.0328 respectively. As for GHG, these two series of results indicate that odour emissions were positively impacted by the presence of a blown chopped straw cover on the surface of the stored manure. Average odour emissions during the spring, summer and fall seasons measured in this study were respectively 0.0369, 0.0276 and 0.0294. Finally, average odour emissions during the daytime period, as measured in this study, were 0.0241 during the morning (07:00 to 10:00), 0.0273 at noon (11:00 to 14:00) and 0.0235 during the afternoon (15:00 to 18:00).

Odour concentrations and intensities were measured over a 2-year period (2002 and 2003) on three swine operations equipped with a conventional pig manure storage tank, an aerobic-anoxic manure treatment system and a biofilter manure treatment system in Québec. The aerobic-anoxic manure treatment system (1.7 OU/s-m<sup>3</sup>) emitted fewer odours than the biofilter treatment system (7.3 OU/s-m<sup>3</sup>). Odour intensities, in ppb equivalent of 1-butanol, emanating from the site with the aerobic-anoxic treatment system were less important than those emanating from the two other sites.

PROJECT: PARTNERSHIP BETWEEN SASK PORK, CANADIAN INSTITUTE FOR HEALTH RESEARCH AND THE CENTRE FOR AGRICULTURAL MEDICINE IN PROVISION OF A POTENTIAL POSITION IN ENVIRONMENTAL AND OCCUPATIONAL HEALTH

SASK PORK PROJECT # 2000-12

Dr. James Dosman  
Centre for Agriculture Medicine  
University of Saskatchewan  
103 Hospital Drive  
Saskatoon, Saskatchewan S7N 0W8

A Sask Pork /CIHR Chair Position in Environmental and Occupational Health in the Animal Industry is located at the University of Saskatchewan. The Centre for Agricultural Medicine at the University of Saskatchewan and Laval University will form a strategic alliance of researchers who will work on characterizing and improving air quality and occupational health status of workers in intensive livestock production buildings over a five-year project.

This is a joint project with co-applicants from Prairie Swine Centre Inc., U of S College of Agriculture, Western College of Veterinary Medicine (U of S), University of Alberta, Veterinary Infectious Disease Organization (VIDO), University of Toronto, Lethbridge Research Centre, University of Quebec and Institut de recherche et de developpement en agroenvironnement.

Start Date: 2001  
Completion Date: 2005  
Funded by: Pork industry check-off and Pork Industry Sustainability Fund

Progress Reports: July 2004

*This project was approved in 2000 but did not get underway until the latter part of 2001. The Industry Sustainability Funded portion of the project completed in 2003 with the balance of funding from the Check-Off. The project will be completed in 2005.*



## Summary of Results

The Occupational Health and Services program continues to be of growing interest to a number of the larger livestock production facilities in Western Canada.

The occupational health services program continues to be a resource for livestock producers. The industrial hygienist, the occupational health physician and our extension division respond to requests related to worksite health and safety issues. Requests typically relate to dust, gas and noise assessment and control issues and individual workplace health and safety issues.

The IAREH has worked with Saskatchewan Labour on the draft of the *Saskatchewan Best Practices* guide. The guide as well as technical modules on selected issues relevant to all livestock industries is under development.

The IAREH works with the swine industry evaluating the respiratory health of workers and assessing the environmental agents present in the workplace. In the initial 1990-1991 research project 331 swine workers in Saskatchewan were studied. 249 of the workers' respiratory health was compared to a set of grain farmers and a set of people who had never farmed. The finds from the study indicated that the study participants were all males between the ages of 18 and 80 years. They had worked for an average of 12 years in the industry at an average of four hours per day in barns that housed, on average, 891 pigs. Swine workers had significantly lower lung function compared with grain farmers and significantly more symptoms of chronic bronchitis and asthma than did grain farmers or people who did not farm.

The group was tested again in 1994-1995. Follow up findings indicated that swine workers experienced a 26.1 mL/year greater decline in lung function when compared to individuals who had never farmed and that grain and swine farming should be considered risk factors in the development of potential airways limitation in these workers. It also appeared that levels of dust and endotoxin in these work environments played a role in respiratory health effects.

A third follow-up was undertaken in 2003-2004. The findings indicated that swine workers had a 43.6 mL/year greater decline in lung function when compared to individuals who had never farmed. The results further suggest that for those individuals that left swine farming, their lung function did not decrease as much per year as it did for those who continued to swine farm.

The swine industry has changed considerably since the original studies were conducted in 1990-1991. The hours of work/day, the number of animals/barn and the length of time the workers have been working in the industry are quite different from the original studies. To better understand the respiratory effects related to this new environment, IAREH



has undertaken a research study on full-time, male and female swine workers. The study will include a questionnaire on health status, respiratory status, job related questions such as number of years in the industry and hours of work per day and lung function testing, blood pressure testing and allergy testing. Data collection will begin in the winter of 2004.

**PROJECT: MANURE AS A SUSTAINABLE SOURCE OF PLANT NUTRIENTS  
SASK PORK PROJECT # 2000-09**

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51 Campus Drive  
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To determine the longer-term effects of manure additions on soil physical properties. Such effects on soil organic matter are really only revealed after several years of application. Essential agronomic and environmental measurements will be made each year. Currently no documented long-term manure trials exist in Saskatchewan.

Start Date: Fall 2000  
Completion Date: Spring 2002  
Progress Reports: June 13, 2001  
December 19, 2001  
May 2002  
January 14, 2003 - FINAL REPORT\*  
\* Electronic Copy Available

## Summary of Results

The objective of this project was to monitor the effect of different rates, sequences and methods of application of swine manure on soil nutrients and crop yield in 2001 and 2002 at a site in the Black soil zone near Dixon in east-central Saskatchewan. Rates of application were 3300, 6600 and 13,200 gallons per acre applied annually and every second or third year. These application rates were equivalent to adding approximately 75, 150 and 300 kg N / hectare respectively, based on manure analysis. Dry conditions were experienced in 2001 and especially in 2002, compared to previous years in this long term study. Despite dry conditions, significant yield responses to manure addition were observed in the spring wheat crop in 2001 and the flax crop in 2002. Annual applications of 3300 gallons per acre gave the best crop responses and resulted in limited residual nitrate left behind in the soil at the end of the growing season. Annual applications of hog manure at the medium and high rates produced excessively high residual soil nitrate, with evidence of nitrate movement below 60 cm depth in the repeated annual high rates. No significant impacts were observed on soil available P content at either low or high rates. Injected applications were superior to broadcast applications in agronomic performance. Under the very dry spring conditions of 2002, some delay in flax germination and emergence was noted in both the swine manure and commercial fertilizer treatments especially at the higher rates applied the previous fall, but a significant flax grain yield response was still observed from addition of swine manure or commercial fertilizer. It is concluded that the optimum management practice for swine manure under the conditions of this study is annual application by injection at ~ 75 to 100 kg N / ha or application at 150 to 200 kg N / ha once every three years, as these treatments produced the best yield with no adverse effects on nutrient accumulation, movement or soil quality.

PROJECT: LONGER TERM EFFECTS OF LIQUID SWINE EFFLUENT ON SOIL  
PHYSICAL PROPERTIES  
SASK PORK PROJECT #2000-08

Dr. Mike Grevers  
Department of Soil Science  
University of Saskatchewan  
51 Campus Drive  
Saskatoon, Saskatchewan S7N 5A8  
Tel: (306) 966-6858  
Fax: (306) 966-6881

The objective of the project is to determine if repeated applications of liquid hog manure under dryland conditions in Saskatchewan result in deteriorating soil structure and therefore crop production. Fields that recently received repeated applications of hog manure will be sampled and analyzed for soil physical and soil chemical properties.

Start Date: Summer 2000  
Completion Date: December 2001 (Completion date extended to December 2002)  
Progress Reports: June 25, 2001  
December 24, 2002 - FINAL REPORT

### Summary of Results

In the first year (2000) of the project the sites in the Black Soil Zone were sampled (Humboldt area). The results indicate a trend of increased soil salinity and sodicity following repeated (4 years) applications of either cattle manure or of hog manure. Soil aggregation was reduced at one site. Soil-water infiltration data and those for soil crusting potential are currently being analyzed. Details of the results are presented in Appendix A of the final report. The second year of the project involved sampling of the sites in the Brown Soil Zone (Beechy and Riverhurst).

Four annual applications of hog manure resulted in a slight effect on soil structure and on soil chemical conditions. For the duration of the project there were no serious effects on either soil physical conditions or on soil chemical conditions. However, the data indicates that longer term application (in excess of 4 years) potentially will result in increased salinity and sodicity, which will effect soil structure. Saline soils restrict plant-water uptake, and sodic soils develop surface crusts.

The result indicate that hog manure should be applied as follows:

- a) Clay-textured soils: once every 4 years (or possibly once every 3 years under optimum soil moisture conditions), at approximately 6,000 gallons per acre (between 150 to 200 lbs of N/acre)
- b) Sandy-loam textured soils and irrigated sandy-loam textured soils: once every 3 - 4 years at approximately 5,000 gallons per acre (150 lbs/N per acre).

### Future Research

Additional research should be done to investigate the longer-term effects of hog manure application, beyond 4 years, especially in regards to the effect on soil physical and chemical properties. The above recommendations do not include a 5<sup>th</sup> or a 6<sup>th</sup> year and were based on 2 out of 4 very dry growing seasons. The frequency of applications of hog manure under different crop rotations and soil-moisture regimes that include a 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup> year etc. needs to be studied to further expand the above recommendations.

**PROJECT: RESEARCH CHAIR IN ENVIRONMENTAL ENGINEERING FOR THE  
PORK INDUSTRY (Established January 2000)**

Claude Laguë, P.Eng.(Qc), Ph.D.

Sask Pork Chair in Environmental Engineering for the Pork Industry

Department of Agricultural & Bioresource Engineering

College of Engineering, University of Saskatchewan

57 Campus Drive

Saskatoon, Saskatchewan S7N 5A9

The Chair is responsible for conducting research projects of a strategic nature on manure processing, handling and utilization technology; catalyze an increased involvement of current engineering faculty in the College of Engineering in solving manure-related problems faced by the prairie pork industry; foster collaboration and coordination of research on engineering and non-engineering aspects of manure management and associated environmental issues; assist researchers to focus on strategic industry needs.

The Chair will act as a technical resource for the swine industry, to speak to and for the industry as a rational voice in discussions about alternative technologies that might be used for manure management, to be an informed voice in a sea of confusing accusations and claims, to assist new and existing producers to make good choices for selecting sites for facilities, management of manure storage and processing facilities, etc.

|                   |                           |
|-------------------|---------------------------|
| Start Date:       | January 1, 2000           |
| Completion Date:  | December 31, 2003         |
| Progress Reports: | January - April 2000      |
|                   | May - August 2000         |
|                   | May - August 2001         |
|                   | September - December 2000 |
|                   | January - April 2002      |
|                   | May - August 2002         |
|                   | September - December 2002 |
|                   | January - April 2003      |
|                   | May - August 2003         |
|                   | September - December 2003 |
|                   | January - April 2004      |
|                   | May - August 2004         |
|                   | September - December 2004 |



**PROJECT: PORK INDUSTRY VIEWING GALLERY & INTERPRETIVE CENTRE  
PROJECT - APRIL 2001**

Lee Whittington  
Manager, Information Services  
Prairie Swine Centre Inc.  
Box 21057 -8<sup>th</sup> Street East  
Saskatoon, Saskatchewan  
S7N 5N9

Pork production is undergoing unprecedented change throughout North America and around the world. In recent years, capital investment in production and processing facilities in western Canada have never been greater. Pig barns today look and operate very differently from those of previous generations.

The interpretive centre / viewing gallery will provide a window on the pork industry with an opportunity for members of the general public, school groups, future neighbors and federal/provincial/municipal legislators and regulators to see the operations of a modern commercial pork producing farm without the issue of biosecurity.

The centre will also provide a resource that can be used by the Prairie pork industry (pork producers, pork producer organizations, industry suppliers and government departments and agencies) to focus their resources and activities that seek to improve the profile of the pork industry.

Progress Reports: Viewing Gallery Opened March 2003

**PROJECT: INVESTIGATION OF IMMUNOGLOBULIN - INDEPENDENT  
ANTIMICROBIAL SUBSTANCES IN PORCINE MILK AND COLOSTRUM  
SASK PORK PROJECT # 1999-05**

Elemir Simko, DVM, DVSc  
Associate Professor in Anatomic Pathology  
Department of Veterinary Pathology  
Western College of Veterinary Medicine  
52 Campus Drive  
Saskatoon, Saskatchewan S7N 5B4  
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Diarrhea is the most important and most common infectious cause of morbidity and mortality in suckling and weaned piglets causing significant economic losses in modern swine industry. Several researchers have reported that 2.7% to 6% of piglets born alive die from scours as the primary cause. These losses are likely underestimated, because gastrointestinal problems predispose to death from hypoglycemia, dehydration, septicemia, starvation, weakness, and trauma (laid on by the sow). The majority of intestinal infectious agents cause disease only when introduced in high numbers (frequently due to poor hygiene) or when intestinal defenses are compromised.

The project investigated immunoglobulin-independent protective substances present in the milk of pigs. The main focus was on identifying colostral/loctogenic *anti-adhesive* and *antibacterial* components that are involved in the first line of defense by preventing bacterial attachment to the lining of the intestines and/or by direct bacterial killing. The following aspects will be examined and determined:

1. antibacterial activity in fresh porcine colostrum/milk
2. bacterial-binding activity in fresh porcine colostrum/milk
3. antibacterial and bacterial-binding activities in digested porcine colostrum/milk
4. biochemical characterization of isolated antibacterial and bacterial-binding components
5. anti-adhesive functions/mechanisms of identified antibacterial and bacterial binding proteins.

Start Date: October 1999  
Completion Date: October 2002  
Progress Reports: May 10, 2001  
June 6, 2001  
September 11, 2002  
April 1, 2003 - FINAL REPORT

**Summary of Results**

The intensive farrowing system with shortened nursing periods results in decreased exposure of piglets to protective components in maternal milk. A possible result is decreased resistance to infectious diseases in weaned piglets. This project has investigated non-immunoglobulin protective substances in porcine milk that kill bacteria or prevent their attachment to the host.

We demonstrated that pepsin-digested porcine lactoferrin, a defense protein, and casein, a nutritional protein, have a potent bactericidal effect on *E. coli*. This antimicrobial activity of porcine lactoferrin and casein generated by pepsin digestion (similar to normal gastric digestion of piglets) might be an important defense of neonates against bacteria.

We discovered nine non-immunoglobulin proteins in porcine milk that bind lipopolysaccharide (LPS). Bacteria that cause septicemia and endotoxemia that are more prevalent in weaned than in nursed piglets. Absence of these proteins in diet of weaned piglets might be contributing to the higher incidence of endotoxemia/septicemia after weaning.

To cause diarrhea, bacteria must attach to intestines via fimbriae. We discovered over ten non-immunoglobulin proteins that bind to isolated *E. coli* fimbriae F4, and that might interfere with bacterial attachment and prevent disease.

Providing that protective function of these substances is confirmed *in vivo*, their supplement to diet of early-weaned piglets should increase disease resistance during critical post weaning periods.

**PROJECT: SWINE MANURE TANKER TRUCK / INJECTOR SYSTEM FOR MANURE  
MANAGEMENT RESEARCH/DEMONSTRATION**

Gordon E. Hultgreen, P.Ag.  
Prairie Agricultural Machinery Institute (PAMI)  
Box 1150  
Humboldt, Saskatchewan S0K 2A0  
Tel: (306) 682-5033 Fax: (306) 682-5030  
Toll free 1-800-567-7264 [www.pami.ca](http://www.pami.ca)

The project includes the purchase of a manure tanker truck/injector system to develop a mobile application system to allow the efficient expansion of quality swine manure research and demonstration projects at reduced cost in Saskatchewan and Manitoba. The mobility and efficiency of the unit will double the current research and demonstration capability with a variety of injection openers and result in a much higher profile for environmentally sound swine manure application methods.

Start Date: May 31, 1999  
Completion Date: May 31, 2000  
Progress Reports: March 2000 FINAL REPORT

**PROJECT: CONTROL OF STREPTOCOCCUS SUIS BY USING NEEDLE-LESS  
VACCINATION**

Philip Willson  
Veterinary Infectious Disease Organization (VIDO)  
120 Veterinary Road  
Saskatoon, Saskatchewan S7N 5E3  
Tel: (306) 966-7465 Fax: (306) 966-7478

The objective of the project is to boost the profitability of swine production by developing a prevention tool that producers can use to control the common diseases caused by *strep suis*. The plan is to use traditional and needle-less vaccination methods to vaccinate pigs using experimental vaccines. Future work would lead to demonstration of an economic advantage resulting from vaccination under field conditions.

Start Date: 1999 (Approved for Funding May 7, 1999)  
Completion Date: 2002  
Progress Reports: August 21, 2001  
July 2002 - FINAL REPORT

**DEVELOPMENT OF SUBUNIT STREPTOCOCCUS SUIS VACCINES**

Dr. Philip Wilson  
(Partnership project with: U of S, Alberta Pork  
Ontario Pork  
Manitoba Pork  
SPI Marketing Group)

Progress Report: June 23, 2000 - FINAL REPORT

**PROJECT: REDUCTION OF ODOR/GAS EMISSIONS FROM GROWER/FINISHER  
BARNs AND MANURE STORAGE FACILITIES**

Dr. John Feddes, Professor  
Department of Agriculture, Food and Nutritional Science  
University of Alberta  
Faculty of Agriculture, Forestry & Home Economics  
410 Agriculture/Forestry Centre  
Edmonton, Alberta T6G 2P5  
Tel: (780) 492-0105 Fax: (780) 492-9130

The project focuses on research that primarily addresses the odor issue. By reducing the site sources of odor to only the building, available technology can be applied to minimize odor/gas emissions to the receiving environment. By isolating the manure storage/dunging area airspace from that of the workers and pigs, overexposure to gases will not occur and by removing odor/gases from the barn, air quality will be improved for workers and animals.

Start Date: May 1998  
Completion Date: March 2001  
Progress Reports: December 2001 - FINAL REPORT



**PROJECT: COMMUNICATIONS LIAISON FOR THE PORK INDUSTRY**

Sask Pork  
Bay 2, Main Floor, 502 45<sup>th</sup> Street  
Saskatoon, Saskatchewan  
S7L 6H2  
Tel: (306) 244-7752  
Fax: (306) 244-1054

The position was developed to manage and carry out the Saskatchewan Pork Industry Communications Strategy, under the auspices of Sask Pork to:

- Provide an analysis of the Pork Industry Communications Strategy and update as appropriate in consultation with the Leadership Group;
- Implement and manage the Pork Industry Communications Strategy;
- Develop and sustain a proactive working relationship with the key stakeholders in the Saskatchewan Pork Industry;
- Maintain knowledge of the overall agricultural industry, issues and players in the province;
- Develop, implement and manage a Funding Model for the Communications Strategy.
  - Identify and access complementary sources of funding
  - Identify and develop program support options
  - Identify and approach potential investors.

Start Date: January 1, 2000  
Completion: December 31, 2001





